

Syllabus for Minor Degree in AI & ML for Minor Degree in “Artificial Intelligence and Machine Learning”

Course Structure							
S. No	Course Code	Title	L	T	P	Credits	Semester
1	MINOR301A	Introduction to AI & Machine Learning	3	0	2	4	3
2	MINOR401A	Introduction to Data Analytics	3	0	2	4	4
3	MINOR501A	Deep Learning and Neural Network	3	0	2	4	5
4	MINOR601A	Special topics in Artificial Intelligence	3	0	0	3	6
5	MINOR701A	Applications of AI	3	0	0	3	7
6	MINOR881A	Projects in AIML	0	0	2	2	8
TOTAL			15	0	6	20	

Course Coding Nomenclature:

- AIML denotes that minor degree in “Artificial Intelligence and Machine Learning”.
- 01, 02, 03, 04, 05 are course in order they have to be taken, if taken in different semesters. Multiple course may also be taken in the same semester (if required).

Detailed Syllabus

Course Code	:	MINOR301A
Course Title	:	Introduction to AI & Machine Learning
Number of Credits	:	4 (L: 3; T: 0; P: 2)
Course Category	:	MINOR
Pre- Requisite	:	Basic Mathematics (especially Linear Algebra and Probability) & Python Programming

Course Objective:

- To review and strengthen important mathematical concepts required for AI & ML.
- Introduce the concept of learning patterns from data and develop a strong theoretical foundation for understanding state of the art Machine Learning algorithms.

Course Contents:

[Total Theory Duration: 42 Lectures] Module 1: [Duration: 12 Lectures]

Defining Artificial Intelligence, Defining AI techniques, Using Predicate Logic and Representing Knowledge as Rules, Representing simple facts in logic, Computable functions and predicates, Procedural vs Declarative knowledge, Logic Programming, Mathematical foundations: Matrix Theory and Statistics for Machine Learning.

Module 2: [Duration: 8 Lectures]

Idea of Machines learning from data, Classification of problem –Regression and Classification, Supervised and Unsupervised learning.

Module 3: [Duration: 10 Lectures]

Linear Regression: Model representation for single variable, Single variable Cost Function, Gradient Decent for Linear Regression, Gradient Decent in practice.

Module 4: [Duration: 7 Lectures]

Logistic Regression: Classification, Hypothesis Representation, Decision Boundary, Cost function, Advanced Optimization, Multiclassification (One vs All), Problem of Overfitting.

Module 5: [Duration: 5 Lectures]

Discussion on clustering algorithms and use-cases centered around clustering and classification. Lab Work:

1. Implementation of logical rules in Python.
2. Using any data apply the concept of:
 - a. Liner regression
 - b. Gradient decent
 - c. Logistic regression
3. To add the missing value in any data set.
4. Perform and plot under fitting and overfitting in a data set.
5. Implementation of clustering and classification algorithms.

Text Books/References:

1. Saroj Kaushik, Artificial Intelligence, Cengage Learning, 1st Edition 2011.

2. Anindita Das Bhattacharjee, “Practical Workbook Artificial Intelligence and Soft Computing for beginners, Shroff Publisher-X team Publisher.
3. M.C. Trivedi, A Classical Approach to Artificial Intelligence, Khanna Publishing House, Delhi.
4. Jeeva Jose, Introduction to Machine Learning, Khanna Publishing House, Delhi.
5. Yuxi (Hayden) Liu, “Python Machine Learning by Example”, Packet Publishing Limited, 2017.
6. Tom Mitchell, Machine Learning, McGraw Hill, 2017.
7. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2011.

Corresponding Online Resources:

1. Artificial Intelligence, https://onlinecourses.nptel.ac.in/noc23_cs18/preview

Course Outcomes: After completion of course, students would be able to:

1. Design and implement machine learning solutions to classification, regression and clustering problems.
2. Evaluate and interpret the results of the different ML techniques.
3. Design and implement various machine learning algorithms in a range of Real-world applications.

Course Code	:	MINOR401A
-------------	---	-----------

Course Title	:	Introduction to Data Analytics
Number of Credits	:	4 (L: 3; T: 0; P: 2)
Course Category	:	MINOR
Pre- Requisite	:	Basic Statistics

Course Objective:

- Provide you with the knowledge and expertise to become a proficient data scientist
- Demonstrate an understanding of statistics and machine learning concepts that are vital for data science;
- Produce Python code to statistically analyse a dataset;
- Critically evaluate data visualisations based on their design and use for communicating stories from data;

Course Contents:

Module 1: [Duration: 7 Lectures]

Introduction to Data Science, Different Sectors using Data science, Purpose and Components of Python in Data Science.

Module 2: [Duration: 7 Lectures]

Data Analytics Process, Knowledge Check, Exploratory Data Analysis (EDA), EDA Quantitative technique, EDA- Graphical Technique, Data Analytics Conclusion and Predictions.

Module 3: [Duration: 11 Lectures]

Feature Generation and Feature Selection (Extracting Meaning from Data)- Motivating application: user (customer) retention- Feature Generation (brainstorming, role of domain expertise, and place for imagination)- Feature Selection algorithms. Module 4: [Duration: 10 Lectures]

Data Visualization- Basic principles, ideas and tools for data visualization, Examples of inspiring (industry) projects- Exercise: create your own visualization of a complex dataset. Module 5: [Duration: 7 Lectures]

Applications of Data Science, Data Science and Ethical Issues- Discussions on privacy, security, ethics- A look back at Data Science- Nextgeneration data scientists.

Lab Work:

1. Python Environment setup and Essentials.
2. Mathematical computing with Python (NumPy).
3. Scientific Computing with Python (SciPy).
4. Data Manipulation with Pandas.
5. Prediction using Scikit-Learn
6. Data Visualization in python using matplotlib Text Books/References:
 1. Joel Grus, Data Science from Scratch, Shroff Publisher Publisher /O'Reilly Publisher Media
 2. V.K. Jain, Data Sciences & Analytics, Khanna Publishing House
 3. Annalyn Ng, Kenneth Soo, Numsense! Data Science for the Layman, Shroff Publisher Publisher
 4. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk from The Frontline. O'Reilly Publisher Media.
 5. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press.

Corresponding Online Resources:

1. Data Analytics, https://onlinecourses.swayam2.ac.in/ntr24_ed70/preview Course

Outcomes: After completion of course, students would be able to:

1. Explain how data is collected, managed and stored for data science;
2. Understand the key concepts in data science, including their real-world applications and the toolkit used by data scientists; 3. Implement data collection and management scripts using MongoDB.

Course Code	:	MINOR501A
Course Title	:	Deep Learning and Neural Network

Number of Credits	:	4 (L: 3; T: 0; P: 2)
Course Category	:	AIML
Pre-requisite	:	Introduction to AI & Machine Learning

Course Objective:

- To strengthen important Mathematical concepts required for Deep learning and neural network.
- To get a detailed insight of advanced algorithms of ML.

Course Contents:

[Total Theory Duration: 42 Lectures] Module 1: [Duration: 8 Lectures] Information flow in a neural network, understanding basic structure and ANN.

Module 2: [Duration: 8 Lectures]

Training a Neural network, how to determine hidden layers, recurrent neural network.

Module 3: [Duration: 10 Lectures]

Convolutional neural networks, image classification and CNN.

Module 4: [Duration: 9 Lectures]

RNN and LSTMs. Applications of RNN in real world.

Module 5: [Duration: 7 Lectures]

Creating and deploying networks using tensor flow and keras.

Lab Work:

1. Introduction to Kaggle and how it can be used to enhance visibility.

2. Build general features to build a model for text analytics.
3. Build and deploy your own deep neural network on a website using tensor flow.

Text Books/References:

1. Rajiv Chopra, Deep Learning, Khanna Publishing House.
2. John Paul Mueller, Luca Massaron, Deep Learning for Dummies, John Wiley & Sons.
3. Adam Gibson, Josh Patterson, Deep Learning, A Practitioner's Approach, Shroff Publisher /O'Reilly Publisher Media.
4. Christopher M. Bishop, Neural Networks for Pattern Recognition, Oxford. Corresponding Online Resources:
 1. Fuzzy Logic and Neural Networks, https://onlinecourses.nptel.ac.in/noc21_ge07/preview Or
 2. Fuzzy Logic, https://onlinecourses.nptel.ac.in/noc22_ee21/preview

Course Outcomes: After completion of course, students would be able:

1. To design and implement Artificial Neural networks.
2. To decide when to use which type of NN.

Course Code	:	MINOR601A
-------------	---	-----------

Course Title	:	Special topics in Artificial Intelligence
Number of Credits	:	3 (L: 3; T: 0; P: 0)
Course Category	:	AIML
Pre-requisite	:	Basic Understanding of Machine Learning Algorithms & Understanding of Neural Networks and Deep Learning

Course Objective: To give fundamental knowledge to the students so that they can understand what the AI is and study important topics related to the field.

Course Contents:

[Total Theory Duration: 42 Lectures] Module 1: [Duration: 9 Lectures]

Bayesian Filtering; Recurrent Neural Networks, Deep Neural Networks, Deep Reinforcement Learning.

Module 2: [Duration: 7 Lectures]

Self-Play Networks, Generative Adversarial Networks, Learning from Concept-Drifting Data Streams.

Module 3: [Duration: 9 Lectures]

Audio Signal Processing Basics, mirtoolbox contains many useful audio processing library functions, VOICEBOX: Speech Processing Toolbox for MATLAB, Audio processing in Matlab.

Module 4: [Duration: 10 Lectures]

Architectures for second generation knowledge based systems, Distributed AI and its applications.

Module 5: [Duration: 7 Lectures]

An introduction to neurocomputing and its possible role in AI, The role of uncertainty measures and principles in AI.

Text Books/References:

1. Dr. Nilakshi Jain, Artificial Intelligence: Making a System Intelligent, John Wiley & Sons.
2. M.C. Trivedi, A Classical Approach to Artificial Intelligence, Khanna Publishing House, Delhi.
3. Artificial Intelligence & Soft Computing for Beginners, 3rd Edition-2018, by Anindita Das, Shroff Publisher Publisher.
4. Artificial Intelligence: A Modern Approach, 3rd Edition, by Stuart Russell and Peter Norvig, Pearson Publisher.
5. New Artificial Intelligence (Advanced), Takashi Maeda and Fumio Aoki, Ohmsha Publisher.

Corresponding Online Resources:

1. Machine Learning and Deep Learning - Fundamentals and Applications, https://onlinecourses.nptel.ac.in/noc24_ee146/preview

Course Outcomes: After completion of course, students would be able:

1. To understand various AI techniques.
2. To decide when to use which type of AI technique.

Course Code	:	MINOR701A
Course Title	:	Applications of AI
Number of Credits	:	3 (L: 3; T: 0; P: 0)
Course Category	:	AIML
Pre-requisite	:	Understanding of Neural Networks and Deep Learning

Course Objective: To give deep knowledge of AI and how AI can be applied in various fields to make the life easy.

Course Contents: [Total Theory Duration: 42 Lectures] Module 1: [Duration: 12 Lectures]

Linguistic aspects of natural language processing, A.I. And Quantum Computing, Applications of Artificial Intelligence (AI) in business.

Module 2: [Duration: 8 Lectures]

Emotion Recognition using human face and body language, AI based system to predict the diseases early, Smart Investment analysis, AI in Sales and Customer Support.

Module 3: [Duration: 7 Lectures]

Robotic Processes Automation for supply chain management.

Module 4: [Duration: 8 Lectures]

AI-Optimized Hardware, Digital Twin i.e. AI Modelling, Information Technology & Security using AI.

Module 5: [Duration: 7 Lectures]

Recent Topics in AI/ML: AI/ML in Smart solutions, AI/ML in Social Problems handling, Block chain and AI. Text Books/References:

1. Sameer Dhanrajani, AI and Analytics, Accelerating Business Decisions, John Wiley & Sons.
2. Life 3.0: Being Human in the Age of Artificial Intelligence by Max Tegmark, published July 2018.

3. Homo Deus: A Brief History of Tomorrow by Yuval Noah Harari, published March 2017.
4. Artificial Intelligence in Practice: How 50 Successful Companies Used AI and Machine Learning to Solve Problems, Bernard Marr, Matt Ward, Wiley.

Corresponding Online Resources:

1. AI, Business & the Future of Work, <https://www.coursera.org/learn/ai-business-future-of-work>

Course Outcomes: After completion of course, students would:

1. To correlate the AI and solutions to modern problem.
2. To decide when to use which type of AI technique.

Course Code	:	MINOR881A
Course Title	:	Projects in AIML
Number of Credits	:	2 (L: 0; T: 0; P: 4)
Semester	:	8 th Semester

Course Objectives

Apply AIML concepts to real-world problems.

1. Develop practical skills in designing, implementing, and evaluating AIML models.
2. Learn to work with various AIML frameworks, tools, and libraries.
3. Understand the importance of data preprocessing, feature engineering, and model evaluation.

Project-Based Learning

Students will work on individual or group projects, applying AIML concepts to real-world problems. Projects may include:

1. Image classification
2. Sentiment analysis
3. Recommendation systems
4. Time series forecasting
5. Chatbots

Assessment

1. Project evaluations

2. Code reviews
3. Written reports and presentations
4. Peer feedback and self-assessment

Course Outcomes: This course outline provides a comprehensive overview of AIML projects, covering both theoretical foundations and practical applications.

1. Students will gain hands-on experience working on projects.
2. Students will develop skills in designing, implementing, and evaluating AIML models.